Project Report: Water–Rock Chemistry and Habitats for Life

Project Investigator: ***James Cowen***

Project Progress

An exciting development related to this NAI project is the funding of a grant to design, construct, and test a prototype instrument for contamination–free sampling of basement rock fluids from deep–sea boreholes. The new University of Hawaii (UH) NAI grant was instrumental in acquiring National Science Foundation (NSF) funds by allowing us to leverage personnel and new expertise assembled through the NAI grant; new NAI–UH post–doc Brian Glazer was recruited in part to help advance this and related projects.

Low temperature hydrothermal ocean fluids (<100° C) circulate everywhere within the porous and permeable volcanic rocks of the upper ocean basement and are subjected to continuous water–rock reactions, providing temperature and chemical gradients, and redox disequilibria that form plausible habitats for a variety of microbial communities. However, this potentially important subseafloor basement rock–fluid biosphere is virtually unexplored and its existence remains controversial. Since most mid–ocean ridge (MOR) flank and ocean basin crusts are buried under thick, impermeable layers of sediment, the fluids circulating within the underlying ocean crust are usually inaccessible for direct studies. Circulation obviation retrofit kit (CORK) observatories affixed to ocean drilling program (ODP) boreholes offer an unprecedented opportunity to study biogeochemical properties and microbial diversity in circulating fluids aging ocean basement. Our target ODP boreholes are drilled through sediments and penetrate into the underlying basaltic crust. They are sheathed by impervious steel liners, designed to prevent direct contribution from sediment pore water; thus fluid exiting the borehole is derived directly from the basaltic crust. A down–hole sampler should substantially overcome concerns of the cumulative contamination of the ascending fluids from chemical and biological processes associated with current borehole casings and possible infiltration of sediment pore waters through any joint leaks.

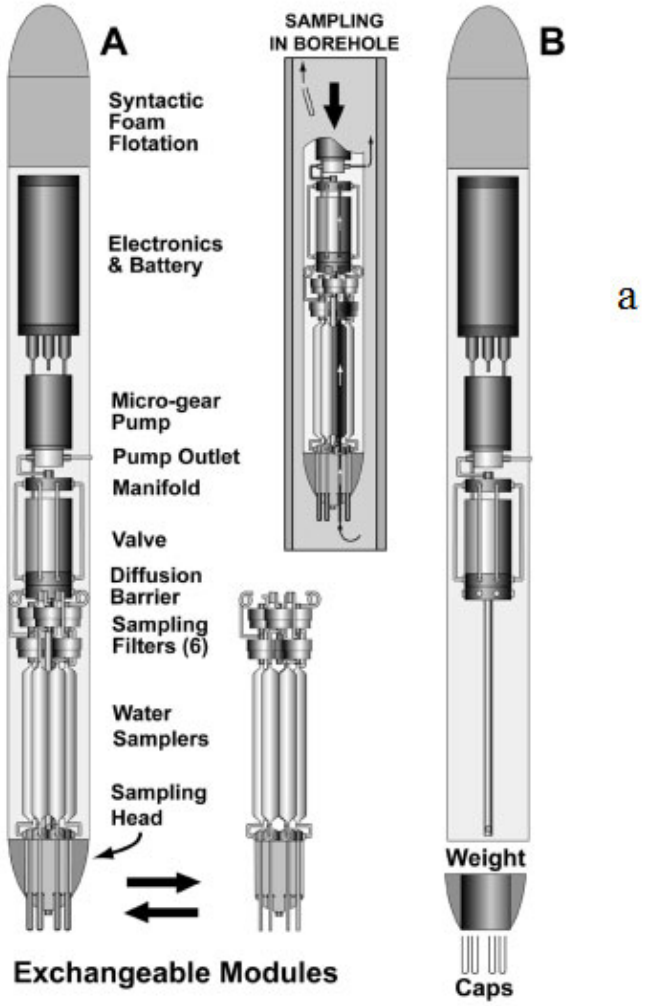

Figure 1. Proposed Downhole Sampler.

Figure 1. Concept drawing of ODP borehole downhole sampler currently under design for construction and deployment (hopefully summer/fall 2005). Drawing by Craig Taylor.

Highlights

- Obtained NSF funding that leverage UH–NAI grant personnel to design, construct, and test a prototype instrument for contamination–free sampling of basement rock fluids from deep–sea boreholes.
- Recruited post–doc Dr. Brian Glazer in part to participate in deep ocean basement microbial geochemical studies.

Roadmap Objectives

- ***Objective No. 5.1:*** Environment–dependent, molecular evolution in microorganisms
- ***Objective No. 5.2:*** Co–evolution of microbial communities
- ***Objective No. 5.3:*** Biochemical adaptation to extreme environments

- ***Objective No. 6.1:*** Environmental changes and the cycling of elements by the biota, communities, and ecosystems

Field Expeditions

Field Trip Name: Borehole–in situ sampling	
Start Date: proposed: 7 or 8/2005	***End Date:***
Continent: NE Pacific Ocean	***Country:*** USA
State/Province: Juan de Fuca Ridge Flanks	***Nearest City/Town:*** Astoria, Oregon
Latitude: 47o 45.8'	***Longitude:*** 127o 45.6'
Name of site(cave, mine, e.g.): ODP Borehole (TBD)	***Keywords:*** basement microbiology, Ocean Drilling Program
Description of Work: Expedition will be to test the in situ, downhole sampler for uncontaminated sampling of geochemical and microbiological parameters of deep ocean basement fluids. This sampler will provide the foundation of extensive future studies.	
Members Involved: Brian Glazer James Cowen	